PROGRESS REPORTS

FROM

EXPERIMENT STATIONS

SEASON 1961-62

NORTHERN NIGERIA

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SAMARU, ZARIA PROVINCE

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Plant Breeding and Plant Physiology ...	D. A. Lawes, B.Sc.
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NORTHERN NIGERIA

PROGRESS REPORT FOR THE SEASON 1961-62

Sowing period: June to September.
Picking period: November to March.
Close season: April to June.

General Introduction

BY

M. A. CHOYCE and J. M. MUNRO

Season and General

The 1961-62 season proved most unfavourable for the commercial cotton crop, and the production of only 159,704 bales of lint was very disappointing indeed after last year's record crop. The poor crop can be largely accounted for by the poor rainfall distribution. The early rains, except for isolated heavy storms, were irregular and below average throughout the country. This delayed the sowing of staple cereals, and greatly increased the proportion of late sown cotton. The rapid onset of the dry season, following poor rains in September, reduced still further the chances of obtaining a good yield from late sown plots and also intensified the losses attributable to insect pests; the more timely sown plots unprotected from insects were unable to compensate for early losses of fruiting points by further growth later in the season.

The total seed issue of 18,017 tons, all Samaru 26J, was a little higher than last year, and 9,450 tons were dressed with a mercurial dust at Funtua ginnery. Observations on the incidence of bacterial blight have shown that the highest levels of infestation occur in the eastern provinces of Northern Nigeria where seed dressing has not yet been introduced.

At Samaru, where it is possible to devote more care to cultivations, early sowing and pest control, seasonal effects were minimized, and good yields obtained despite the abnormally dry season. Even here, however, there was a noticeable absence of a top crop on some fields.

In the programme of selecting and testing new strains of cotton no marked advance can be reported, and a probable successor to Samaru 26J New Blend requires further testing. The hybridization programme has been expanded to provide breeding material with additional variability. It is hoped that crosses using a range of introduced types will lead to progress in selecting for higher yield, improved resistance to bacterial blight, and lint with improved characteristics, particularly fibre strength.

The application of the results of the studies on crop and soil water relationships to sorghum and groundnuts has led to yield increases

though not of the spectacular magnitude of those obtained on cotton. This was not unexpected as the highest yields of these crops in Northern Nigeria were already similar to those recorded in other countries.

Reasonable increases in yield following the use of insecticides on cotton were recorded at those stations where recommendations could be closely adhered to. Very variable results from other spraying trials have confirmed that the introduction of new techniques into the cotton growing industry will be a major problem for the agricultural extension services.

Staff, Visitors and Buildings

The following staff changes took place during the year: Mr J. M. Munro left for Uganda on 26th February, 1962, to take up his appointment as Director of the Cotton Research Station at Namulonge. Mr M. A. Choyce succeeded him as Senior Officer of the Corporation in Nigeria.

Mr B. J. S. Lee proceeded on leave on 2nd December, 1961, visiting Namulonge on his way before transferring to Ibadan, Western Nigeria. He was replaced by Mr J. L. Palmer, who arrived on 8th September, 1961.

Mr W. Reed proceeded on leave on 23rd October, 1961, before transferring to Ukiriguru, Tanganyika. He was replaced by Mr D. J. de B. Lyon, who arrived on 3rd August, 1961.

The following members of the staff took leave during 1961:

D. A. Lawes	March to August
B. E. Costelloe	April to August
M. A. Choyce	May to September
J. M. Munro	July to November

The Right Honourable, the Earl of Derby, M.C., President of the Council of the Corporation, included Samaru in his itinerary during his visit to Nigeria in February, 1962.

The Director, Mr D. F. Ruston, paid a short visit to Nigeria for discussions with Government and Corporation officers on his way to East Africa.

As a result of negotiations between the Department of Technical Co-operation and the Corporation, the Corporation agreed to post Mr Lee to Western Nigeria in May, 1962. Mr Munro and Mr Lee visited Ibadan in December, 1961, to arrange details of work to be carried out in the 1962-63 season.

The new administrative and laboratory building should be ready for occupation before the end of 1963. Although this building is not intended to house the Corporation staff, its completion will make more office and laboratory space available elsewhere on the station.

TABLE 1

SUMMARY OF SAMARU METEOROLOGICAL DATA FOR 1961

Latitude 11° 11′ N, longitude 07° 38′ E, altitude 2,250 feet

Averages for comparison are given in parentheses

Month	*Rainfall*		*Relative humidity %*		*Air temperature °F screen*		*Sunshine hours per day Campbell Stokes*	*Radiation cal/cm² per day Kipp*	*Evaporation inches 6 ft × 6 ft sunken open pan*
	inches	*days 0·01 or more*	*mean 1000 hours*	*mean 1600 hours*	*mean maximum*	*mean minimum*			
	a	b	c	c	b	b	c		c
Jan.	0·28 (0·01)	1 (0·1)	17·7 (19·5)	14·7 (15·7)	86·9 (88·1)	58·6 (57·6)	8·2 (8·9)	447	6·78 (7·15)
Feb	0·00 (0·06)	0 (0·3)	12·3 (15·4)	9·8 (11·1)	83·5 (90·9)	58·1 (60·5)	8·6 (9·5)	584	7·74 (7·97)
Mar.	0·23 (0·37)	1 (0·1)	17·6 (28·0)	13·9 (16·0)	91·3 (95·8)	63·6 (67·0)	8·9 (9·0)	632	9·75 (8·99)
Apr.	1·47 (1·33)	4 (3·7)	42·5 (52·9)	28·8 (31·0)	95·4 (96·9)	69·7 (71·0)	7·6 (7·9)	581	7·73 (7·44)
May	2·27 (5·16)	5 (10·5)	51·6 (62·5)	32·4 (42·2)	94·5 (91·9)	70·8 (70·1)	8·5 (8·5)	594	8·36 (7·28)
June	8·19 (6·41)	14 (13·0)	72·9 (74·6)	60·3 (60·0)	85·6 (87·7)	67·7 (68·0)	7·4 (8·0)	563	6·82 (5·90)
July	5·68 (8·62)	22 (16·2)	80·3 (80·0)	69·5 (67·9)	81·7 (83·3)	65·8 (67·2)	5·2 (5·8)	446	4·45 (4·86)
Aug.	4·81 (11·39)	17 (20·3)	80·7 (82·3)	72·2 (70·9)	80·0 (81·9)	66·5 (66·9)	4·3 (4·9)	416	4·07 (4·41)
Sept.	9·52 (9·08)	14 (16·8)	74·6 (76·5)	60·3 (63·6)	84·1 (84·8)	65·0 (66·5)	7·0 (6·6)	547	5·53 (5·15)
Oct.	0·00 (1·39)	0 (4·4)	47·2 (58·3)	27·7 (42·6)	89·3 (88·9)	60·6 (63·2)	10·0 (9·1)	603	6·17 (5·68)
Nov.	0·00 (0·04)	0 (0·2)	18·5 (30·9)	14·5 (20·3)	88·7 (90·0)	56·9 (60·5)	10·6 (10·0)	576	6·76 (6·36)
Dec.	0·00 (0·00)	0 (0·0)	16·1 (22·7)	13·2 (17·1)	81·3 (87·6)	50·8 (57·5)	9·2 (9·5)	564	4·17 (6·40)
Total	32·45 (43·86)	78 (85·6)							78·33 (77·59)

a=average for the 38 years 1924 to 1961, b=average for the 24 years 1938 to 1961, c=average for the 8 years 1954 to 1961

Plant Breeding

BY

J. M. MUNRO, D. A. LAWES, B. J. S. LEE, B. E. COSTELLOE and J. L. PALMER

In yield trials the expression of potential differences was curtailed by the rapid cut off of moisture at the end of the rains. Consequently there have been no spectacular results from the programme of selection and testing this season.

Variety Trials

The two trial mixtures QA and QB which were made up last season as described in the 1960-61 Progress Report, were tested in the twelve district variety trials. Samples of lint from six of these trials have been sent for spinning tests; a summary of the results compared with 26J New Blend is given in Table 2.

Table 2

Lint yields and spinning characters of three varieties tested in the district variety trials

Yields are means of twelve experiments

Variety	*Lint yield lb per acre*	*Count × strength at 40s.*	*Yarn appearance*
26J New Blend	157	2414	2·5
QA	168	2423	2·7
QB	158	2400	2·5

There was no difference in neppiness.

Tests of Strains

The strains test sown annually at Samaru, includes a further test of the material in the current district variety trials, along with the other most promising strains.

Insect attack may obscure inherent differences in growth and final yield. It has therefore been decided to run two strains tests, one of which is sprayed with insecticide. The pathologist grades the material on its reaction to bacterial blight, and the resistance to jassids, which are a potential hazard to cotton growing in Northern Nigeria, can be estimated on the unsprayed trial.

This season the mean yield of the sprayed trial was 1,768 lb seed cotton per acre as compared with 914 lb for the unsprayed, and the coefficients of variation were 9·28 per cent and 14·01 per cent respectively.

Two further strains have been picked out from these tests to go forward to the district variety trials next season.

S52 Selections—Selection Index

The selection index technique was used for the sixth successive year in selection between progenies. The progenies tested represented material selected from the previous season, some on the basis of the selection index and others on the basis of high yield. As in previous seasons, no conclusive evidence has been obtained to show that one method of selection is any more successful than the other.

S56 Selections—Modal and Positive Bulks

Modal and positive bulks, described in the Progress Report for 1959-60, were again tested in replicated trials. Despite selection applied over three generations, no differences could be demonstrated between them. Previous seasons' results of this experiment have been published elsewhere (Lee, 1962), and it is concluded that the genetic variability in this material is too low for differences to be demonstrated between bulks made up in these two ways.

S56 Selections—Special Character Progenies

The second stage of the tandem selection programme was commenced this season. Except for a proportion of the material which will provide controls, the criteria for selection of progenies previously selected for high ginning percentage, high yield or high lint length have been interchanged.

Correlations between the characters used followed the pattern of last season, except that the negative correlation between lint yield and lint length was not demonstrated. The detailed results of this long term selection programme will eventually be written up for publication elsewhere.

Hybridization

The surviving crosses from those made in 1954 were grown in the strains test. None showed any advantage over the controls, and they were consequently discarded.

The hybridization programme which was commenced in 1960-61 has been expanded. The major objectives are to produce a range of material not only higher yielding but with lint qualities to suit possible future demands and with increased resistance to bacterial blight.

Seed from the crosses made last season has been multiplied and selfed. This material will be studied in a yield trial next season.

A large number of fresh crosses has been made using as female parents either commercial 26J or the substrain 5/44 which is higher yielding but with slightly inferior spinning qualities. Pollen parents included imported strains from Uganda, Tanganyika and the Republics

of the Sudan, Niger and Tchad; also the 26J substrain 7/36 which is somewhat lower yielding than 26J itself, but has very good spinning characters.

As recorded in last season's report, 5/44 and 7/36 were the strains mixed mechanically in equal proportions to form the mixture QA, which is still undergoing trials. Initial crosses have been made in order to assess the combining ability of the component strains in the Samaru mixtures.

Panmixis bulks were again grown at Gusau, Kontagora and Samaru. Unfortunately the seed for sowing at Gombe was lost *en route*. Samples of seed from each of these bulks were sown in the two strains tests, but no consistent differences in the yield, ginning percentage, lint length or seed weight could be discerned. None of the bulks exceeded 26J in any character except seed weight.

Cross Pollination Studies

The marker gene for the recessive character "glandless" has now been incorporated into a strain embodying most of the field characters of 26J by a programme of back crossing and selection. This strain, for convenience referred to as "Glandless 26J", was sown in a trial to measure the amount of natural outcrossing. The yield of this trial was low, owing to a low level of fertility of the site and a severe attack of insect pests; the results may therefore be unreliable. The results are being obtained by germinating the seed and examining the seedlings produced and this work is as yet uncompleted. One result already available indicates that outcrossing this season could be at least as high as 33 per cent. This figure was obtained by germinating all the seeds produced by an isolated stand (2 plants) of glandless 26J grown within a bed of 26J. The experiment will be continued to cover several seasons.

Seed Types

Samaru 26J seed contains a range of types from tufted to fully fuzzed and of fuzz colours from white to green. Samples of types within this range were separated out and sown in a replicated yield trial. The only statistically significant difference (5 per cent level) demonstrated in the final seed cotton yields was that tufted seed was inferior. Reselections from within the material were made so that the mode of inheritance of these characters may be studied.

In the same trial, the high and low seed weight special character bulks referred to in the 1959-60 and 1960-61 reports were tested. These had been selected solely for high and low seed weight. After two years of selection, the bulks were significantly different for this character, but no significant differences in seed cotton yields could be demonstrated.

Shedding

An experiment was laid down to investigate the causes of bud and boll shedding. A 2^6 factorial design was used, and the treatments included time of sowing, spacing, mulching, crosstying, application of insecticide and fertility differences. Direct counts of buds and bolls shed, and counts of bolls retained were made on sample plants within the plots. The mass of data so obtained proved difficult to interpret and it has become apparent that the trial was too complex. A series of trials using fewer treatments and larger plant samples, will be necessary to give clearer results.

Intercropping of Cotton and Pennisetum Millet

A proportion of the cotton crop in certain areas of Northern Nigeria is intercropped; an attempt has therefore been made to evaluate the components of yield under different populations of this system. It is already well known that the yield of cotton will be highest with a pure stand and will decrease as the competition of the second crop increases. In terms of cash return per acre, however, it may be more profitable to compromise, and it is of special interest to compare cotton early sown within already established millet with timely sown cotton in pure stand.

This season's trial which included combinations of cotton at two populations and two dates of sowing, and millet at four populations, indicated that intercropping may give the highest cash return per acre. A combination of early (mid-June) sown cotton at two foot spacing on three foot ridges with millet sown 5th May was the best. The spacing of the millet, on this year's showing, was not very important. The closest spacing of millet (four feet) did, in fact, give the best return, but this was not statistically significant. The experiment is to be repeated.

Crop Physiology

BY

D. A. LAWES

Climate and General

The total rainfall at Samaru in 1961 was 32·45 inches, which is the lowest ever recorded. Table 1 shows that the monthly totals for July and August, particularly that of August, were well below average. These months were not correspondingly low, however, in the number of days on which measurable rain fell and, throughout the period from late June to the 22nd September, there was only one spell of more than three consecutive days without rain. The last fall of the season

was on 22nd September, after which there was an abrupt change to lower humidities and low night temperatures.

The below average rainfall was not associated with clear sunny days, and the weather could not generally be described as good for growing crops. For food crops passing their critical moisture requirement before the cessation of the rains there was no serious shortage of water despite the low rainfall total. For the cotton crop, on the other hand, with normal sowing date and cultivation, there was not time for plants to set a substantial crop before the moisture supply ceased. Consequently it was to be expected that cultivation treatments which conserved moisture would have more effect on cotton than they did on sorghum and groundnuts.

The field work on crops is now developing in three main stages. Firstly, there are the field investigations which test the effects of manurial and cultivation techniques on growth and yield in replicated trials. Secondly, come the maximum yield plots in which the crops are given the very best treatments at present known, in order to indicate the levels of yield which may be expected and to observe whether the large variations between seasons can be eliminated.

The third stage, which becomes practicable when the others are well advanced, is the analysis of the factors contributing to a good yield and evaluation of their economic worth.

With the cotton crop, all three stages are in progress; some of the results have already been published and others will soon be available. With sorghum and groundnuts only the first two stages have so far been possible.

Replicated Trials

In previous seasons all trials testing cultivation techniques which modify the soil moisture status of the soil, such as different methods of crosstying and mulching, have been of an annual nature using a fresh site each year. As the effects of such treatments may be cumulative, a permanent trial has been laid down in which the cultivation treatments at two levels of fertility are repeated on the same plots from season to season but the three main crops are rotated each year.

The cotton trial, sown on 27th June, was not sprayed against insect pests and was adjacent to another even earlier sown and similarly unprotected plot of cotton. Pest damage was therefore heavy and the results of comparisons between methods of rainfall conservation were inconsistent, although higher yields were obtained by using any conservation technique as compared with open free draining furrows.

The mean yield of all conservation treatments at the high level of fertility was 848 lb seed cotton per acre compared with 681 lb for

free draining furrows. Comparative figures for the lower level of fertility were 794 and 591 lb seed cotton per acre respectively.

The results of the sorghum and groundnut trials will be published elsewhere.

An experiment designed to study the importance of the stage of growth on the plants' reaction to surface flooding, did not give conclusive results as there was little surface flooding this season.

Maximum Yield Plots

The original cotton monocropped plot gave its highest yield yet, 2,687 lb seed cotton per acre. This was the only cotton on the station which set a good top crop. The consistent high yields obtained on this plot are in part due to the uniformity of growth over the area which is itself dependent on the considerable depth of rooting of the plants. This deep rooting tapped an additional reservoir of moisture when the rains ceased; an excellent crop was therefore produced.

On the new maximum yield plots neither uniformity nor deep rooting was obtained, and there was insufficient moisture available to set a good top crop. The overall yield from the one and a half acres was 1,449 lb seed cotton per acre, but subplots, of 144 square yards each, from within the area had yields ranging from 1,899 to 1,143 lb per acre.

The maximum yield plot sown with Short Kaura sorghum gave a yield of 4,303 lb grain per acre, which is even higher than last season's yield of 3,831 lb per acre (wrongly quoted as 3,381 lb in the 1960-61 report).

The third plot, this season growing S38 groundnuts, yielded 1,425 lb kernels per acre compared with 1,400 lb the previous season.

Plots producing very high yields of cotton have, in the past, always received dressings of organic manure. To investigate whether organic manure is essential, or whether the same yields may be obtained with good husbandry and the use of artificial fertilizer applying the same nutrients, two plots were cropped this season. Neither site had received organic manure for at least ten years and one of them was on a soil considered to be poor and shallow overlying solid ironstone. Two hundredweights each of superphosphate and sulphate of ammonia per acre were applied, sowing took place on 21st to 23rd June and spraying against insect pests carried out. These plots also did not yield uniformly; the deeper soil gave an average yield of 1,430 lb seed cotton per acre with subplot variations from 2,090 to 995 lb per acre, and the shallow soil averaged 1,278 lb seed cotton per acre containing a range of from 1,526 to 1,097 lb per acre.

Plant Population

The optimum plant population was again investigated for cotton

grown at the new high levels of fertility, with three sowing dates. There was no indication that closer spacing than that at present recommended gives higher yields at these levels.

The trial was sprayed against insect pests, and sowings on 5th June and 26th June, at a low level of fertility, gave higher yields than sowing on 17th July, at a high level of fertility. The three yields were 1,158, 1,082 and 944 lb seed cotton per acre respectively.

Climatology and Soil Moisture Studies

A Kipp solarimeter was installed in January, 1961. Records from this are presented in Table 1, and are being used in the computation of evapotranspiration losses. Analysis of other meteorological data has continued.

Further information on the moisture holding capacity of the Samaru soils and its availability has accrued, and is being prepared for publication.

Plant Pathology

BY

M. DRANSFIELD

The rather dry conditions were unfavourable for the spread of bacterial blight, especially in the latter half of the season. *Alternaria* leaf spot was serious only on late-sown cotton seedlings; *Ramularia* and *Cercospora* leaf spots were unimportant.

Seed Dressing against Bacterial Blight

Four organo-mercurial dust dressings (Agrosan 5W, Dieldrex A, Tillex and methoxyethyl mercuric silicate), three non-mercurial dusts (Thiotox, JF245 and JF305) and four organo-mercurial liquid dressings (Panogen, Agrosol, Tillex liquid and Mist-O-Matic) were applied to raw 26J seed at rates between 1:300 and 1:100 w/w. After three weeks storage, the dressed seed was sown on 8th July in a randomized block experiment covering about 0·7 acre. None of the dressings was in any way phytotoxic, but at the rates used every compound was less effective than Agrosan 5W (applied at 1:150) in controlling bacterial blight.

The liquid mercurial dressings were very similar to each other in their ability to control bacterial blight; an application rate of 1:100 led to 3-6 per cent infected seedlings four weeks after sowing, contrasted with 2 per cent infection with Agrosan 5W at 1:150. Rates less than 1:100 generally produced about 10-15 per cent infected seedlings. The proportion of infected seedlings grown from untreated seed was 35 per cent.

In a further experiment, Agrosan, specially formulated to contain differing amounts of mercury, was applied at rates between 1 : 200 and 1 : 143, giving a range of mercury loads from 150 to 560 p.p.m. The object was to discover if any economic reduction in bacterial blight would result from applying a greater mercury load. The results were somewhat irregular, but the overall indication is that the present commercial rate of 333 p.p.m. of mercury (1 : 150 of Agrosan 5W) is satisfactory.

It was also demonstrated that smaller amounts of a more concentrated Agrosan formulation were just as effective in controlling blight as a similar mercury load contained in twice the quantity of a more dilute formulation.

Acid treated seed was additionally dressed with the four liquid dressings, each at 1 : 100 and 1 : 400, to discover if the small amount of residual internal infection, which is always present even after acid treatment, would be reduced by the more volatile liquid dressings. The results confirmed last season's work that the effects of liquid dressings and acid treatment are additive to some extent.

A preliminary large plot experiment to determine the effect of seed dressings on yield was a failure owing to the competition for light and nutrients given by the Tall Kaura sorghum barrier used between plots. A resistant Albar cotton (A/58/18) will be used as a barrier next season.

Seed Infestation Experiments

Since 1956, seed obtained annually from different markets has been grown at Samaru to compare the level of seed infestation. This is approximately proportional to the amount of blight in the area where the seed was grown, and as the area sown with dressed seed increases, there should be a progressively lower level of infestation in areas supplied with dressed seed. The highest infestation level is in Bauchi Province and adjacent areas of neighbouring provinces. It is hoped to instal a second seed dressing plant at Kumo ginnery, in the centre of this area.

In Tanganyika it was found that six seeds per hole gave more infected plants than one seed per hole. A similar experiment at Samaru gave 59 per cent infected seedlings with one seed per hole and 72 to 81 per cent with two to six seeds per hole. The depth of sowing did not affect the percentage infection of the plants that emerged, but only 25 per cent of the seeds sown four inches deep germinated, compared with 71 per cent sown at a depth of one inch. No differences in amount

of infection were detected between seedlings from sowings made at a succession of dates at three-day intervals from mid June to mid July.

Plant inoculation with Xanthomonas malvacearum

Previous trials comprising inoculation of plants at the growing point, spraying a culture suspension, and inoculating bolls have been unsuccessful. Other field inoculation methods have given moderately successful results, namely needle inoculation of the leaf midrib and needle inoculation of young stems below the cotyledons. The highly successful techniques have been seed inoculation (for field experiments) and mid rib inoculation (for screenhouse material).

All the 49 strains in the Cotton Breeders' strains test were seed-inoculated and sown in the field. Dressed seed was also sown in polythene bags in the screenhouse and the leaves of selected plants needle inoculated in the midrib. Other leaves were inoculated by the local lesion method. Twenty-four different ways of counting, scoring or grading the resulting diseased plants were used during the season. From general observations, and by calculating the coefficient of variation wherever possible, it was obvious that some data (e.g. length of lesion) gave a more accurate picture of the susceptibility to bacterial blight than other methods. These data were weighted more heavily in drawing up a final rank order of resistance.

The results from each method of scoring were compared with the final rank order, and the following six methods gave results which were closest to the final rank order: length of the six longest lesions in any one strain; mean lesion length on all inoculated leaves; mean lesion length, using the longest lesion per plant only; area of leaf reddening; presence of watersoaked lateral veins and mesophyll; percentage of diseased leaves. All except the last method used plants grown in the screenhouse. Thus observations on screenhouse material appear to be more accurate than on plants inoculated in the field, although far less material can be handled in the screenhouse than in the field, and fungicides have to be used to keep down sooty mould (*Cladosporium herbarum*) which builds up in a screenhouse used continuously for cotton during a season. For field work it seems better to score individual infected leaves rather than the plant as a whole. Furthermore, grading of naturally infected plants in the field presumes an even level of infection, and this method should only be used to augment the results obtained from artificial inoculation.

Cotton of four varieties was sown on 24th June and 8th July, and was sprayed with either trash suspension, culture suspension or water on 4th and 5th August. Both inoculum suspensions contained between 10 and 20 million bacteria per ml as determined by plate counts.

Diseased plants were counted and graded, giving the results shown in Table 3. Trash spraying was much more successful than culture spraying in augmenting natural infection, but the future use of this technique depends on the availability of infected trash; there was so little late spread of infection in 1961 that all plants, even if heavily infected when young, grew away from the disease, and at the end of the rains it was difficult to find even one leaf with bacterial blight.

TABLE 3

BACTERIAL BLIGHT INFECTION OF YOUNG PLANTS FOLLOWING VARIOUS TREATMENTS

Inoculum	*Per cent infected plants*		*Mean grade (0-10)*	
	4 weeks	6 weeks	4 weeks	6 weeks
Culture	32·0	33·0	2·16	2·65
Trash	67·5	92·4	3·36	5·51
Water (control)	20·2	36·0	1·38	2·82

Miscellaneous experiments

It is known from previous experiments that infected trash exposed to weathering for two months is rendered completely sterile, but the shortest period of exposure necessary for complete sterilization was unknown. Infected trash was exposed for periods between two and twenty-nine days under wire netting during June and July, and one teaspoonful of the sieved material was added to the seed hole on top of acid treated 26J seed. Counts of infected plants showed that periods of exposure of more than 19 days rendered the trash completely sterile.

A disease known as "stem-break", which causes the stem to break off at soil level, was again present on the heavily manured maximum yield plot, but was rare elsewhere. After continuous cropping with cotton in this plot there were 6·6 per cent infected plants, but where monocropping had been interrupted by six rows of sorghum in the previous year, only 3.4 per cent of the cotton plants were infected. *Rhizoctonia solani* and *Sclerotium rolfsii* were both consistently isolated from the diseased plants. Both fungi produced symptoms similar to those observed in the field when inoculated into plants grown in the screenhouse; *R. solani* appeared more pathogenic towards younger plants, while *S. rolfsii* produced more severe symptoms in older plants. A soil baiting technique with pieces of dried sunflower stem showed that there was twice as much *R. solani* in the soil of the maximum yield plot (0·67 per cent carbon) as in other soils in which cotton was growing (0·50 per cent carbon).

The fungi present on stained lint from sprayed and unsprayed cotton were compared, but the BHC + DDT spray had not led to any change in the proportion of the species causing lint staining.

Entomology

by

M. A. Choyce, W. Reed and D. J. de B. Lyon

Cotton Pests in 1961—General Notes

Observations on leaf-rollers, mirids, jassids and stainers were made on three fields of cotton sown successively at the beginning of June, July and August. Mirids (*Campylomma* spp.) reached a maximum population in early October in all plots irrespective of sowing date. Leaf-rollers (*Sylepta derogata* (F.)) were confined to the June and July sowings, and large numbers of parasites (*Apanteles syleptae* Ferr. and *Eurytoma* sp.) were present. Jassids (*Empoasca facialis* (J.)) became most numerous on the July sown plot at the boundary of the June and July sowings, indicating that movement from the early sowing had taken place. Jassid damage was very obvious on these plots, and on other cotton fields at Samaru. Stainers (*Dysdercus superstitiosus* (F.)) moved into the June and July sowings soon after flowering began, but the August sowing was almost free from these pests. The overall pest attack on the June and July sowings was particularly heavy, and the yield of seed cotton from each of the three plots was only about 300 lb per acre.

Observations on Diparopsis watersi (Roths.)

Light traps were in operation throughout the season at Samaru and Daudawa. Flight activity of *Diparopsis* was similar to that recorded last season, with populations increasing during September to a maximum in early October. At Daudawa, where cotton was confined to the southern half of the Main Farm, considerably more moths were caught on the cotton than on the non-cotton block. Flight activity at Daudawa was bi-modal, with a pronounced peak in June-July, in addition to that of September-October. This was probably a consequence of the late and sporadic onset of the rains, which resulted in dry soil early in the season.

A comparison of the catches made by kerosene and mercury vapour light traps shows that reasonable numbers of *Diparopsis* are attracted to each type of light. Other pests of cotton, and certain pests of cowpeas, appear to be more readily attracted to the mercury vapour lamp. Sufficient information is now available from the light-trap records for the work to be written up for publication.

Studies on the emergence of *Diparopsis* from short and long term pupae under laboratory and simulated field conditions have continued. The pattern of emergence has been related to rainfall and soil temperature. At Daudawa observations on the rate of parasitism of *Diparopsis* by the Tachinid, *Carcelia evolans* (Wied.), have shown that

this remains at a high level; the tendency for the parasitism rate to be lower on sprayed cotton at the Main Farm than on unsprayed cotton at Shemi continues.

Cotton Seed Multiplication

Yields of sprayed multiplication cotton at Daudawa were similar to those obtained last season, although the rainfall was only 28·52 inches. In contrast, the yield of unsprayed cotton at Shemi was well under half of last season's figure. Details are set out below.

Main Farm, Daudawa	
Sowing date:	18th to 29th June.
Fertilizer:	2 cwt sulphate of ammonia plus 1 cwt single superphosphate per acre.
Insecticide:	5 sprays of DDT (1·2 lb per acre) plus gamma BHC (0·12 lb per acre) between 25th August and 12th October. 1 spray of Sevin (1 lb per acre) from 13th to 17th October.
Yields of seed cotton:	Stage B (30 acres)—851 lb per acre. Stage C (190 acres)—746 lb per acre.
Shemi.	
Sowing date:	30th June to 5th July.
Fertilizer:	2 cwt single superphosphate plus 1 cwt sulphate of ammonia per acre.
Insecticide:	Nil.
Yields of seed cotton:	Stage C (148 acres)—190 lb per acre.

Insecticide Trials at Samaru

(a) *Effect on yield of early and late sprays.*—The standard spray schedule under trial in Northern Nigeria requires six applications of insecticide to be made at weekly intervals, beginning nine weeks after sowing. These sprays give good control of pests other than bollworms during late August and September. At Samaru additional sprays are given on many trials to give better and longer protection against bollworms. To determine the relative effect on yield of the extra insecticide applications a trial incorporating the following four treatments was carried out.

A—Early sprays	Six applications of 1 lb DDT plus $\frac{1}{10}$ lb gamma BHC per acre, beginning nine weeks after sowing.
B—Late sprays	Four applications of 2 lb DDT plus $\frac{1}{5}$ lb gamma BHC per acre, beginning fifteen weeks after sowing.
C—Early plus late sprays	Treatments A and B.
D—No spray applications	

The sprays were applied with "Lancet" hand sprayers. The first application was on 10th August.

The results of the trial are given in Table 4. The highest yield was given by those plots receiving early plus late sprays, but it was not expected that the plots receiving late sprays would outyield those receiving early sprays. This result needs to be interpreted with caution.

The yield of the unsprayed control plots was high at nearly 800 lb seed cotton per acre, and it is probable that the effects of the insecticide extended beyond the boundaries of the sprayed plots. If this is so, it cannot be assumed that those plots receiving late sprays remained unaffected earlier in the season. The trial is to be repeated, dividing it into two experiments, one testing only late sprays, and the other testing early and early plus late sprays.

TABLE 4

EFFECT OF EARLY AND LATE SPRAYS ON COTTON YIELD, SAMARU, 1961

Layout: Six replications of four treatments; plot size 1/13 acre.
Fertilizer: 3 tons farmyard manure, 2 cwt sulphate of ammonia plus 2 cwt single superphosphate per acre.
Sowing date: 9th June.

Treatments (see text for details)	*Yield of seed cotton lb per acre*
A—Early sprays	1146
B—Late sprays	1330
C—Early plus late sprays	1565
D—No sprays	796
S.E.	± 43·8

(b) *A comparison of DDT + BHC and Sevin.*—The results of an experiment in which the standard DDT + BHC spray was compared with Sevin are given in Table 5. In this experiment treatments were included in which every third row of cotton was uprooted at the time of thinning. The missing row facilitated movements of the operator during insecticide applications, and did not lead to any reduction in yield per acre of seed cotton. This can be accounted for by an improved spray coverage, a reduction in crop damage by the operator during spraying, and a compensatory increase in yield from larger plants, in those plots from which complete rows of cotton were removed.

TABLE 5

A COMPARISON OF DDT PLUS BHC AND SEVIN SPRAYS ON COTTON, SAMARU, 1961

Layout: 4 replications of 6 treatments; plot size 1/18 acre.
Spacing: standard, 18 inches apart on 3 ft. ridges.
Fertilizer: 3 tons farmyard manure, 2 cwt sulphate of ammonia plus 2 cwt single superphosphate per acre.
Sowing date: 10th June.
Insecticides: 6 sprays at weekly intervals from 11th August.
Rates: 1 lb DDT plus $\frac{1}{10}$ lb gamma BHC per acre per application.
0·5 lb Sevin per acre per application.

YIELDS OF SEED COTTON IN LB PER ACRE

	All rows present	*Every third row uprooted*	*Mean*
DDT + BHC	1001	1087	1043
Sevin	1083	1173	1128
No insecticide	644	712	678
S.E.			± 40·1
Mean	909	991	
S.E.	± 32·7		

Insecticide Trial at Mokwa

A further trial comparing DDT plus BHC and Sevin was carried out at Mokwa by the Government Entomologist (Mr. J. A'Brook). The results are given in Table 6; there was no significant difference between any of the treatments, but yields were substantially higher than those recorded from unsprayed cotton plots on the station (see below).

TABLE 6

A COMPARISON OF DDT PLUS BHC AND SEVIN SPRAYS ON COTTON, MOKWA, 1961

Layout: 4×4 Latin square; plot size 1/22 acre.

Fertilizer: 2 cwt sulphate of ammonia plus 1 cwt single superphosphate per acre.

Sowing date: 19 June 1961.

Insecticides: six applications at weekly intervals beginning on 21st August, by means of 'Lancet' hand-sprayer.

Treatments *Insecticide active ingredient per acre*	*Yield of seed cotton lb per acre*
1 lb DDT plus $\frac{1}{10}$ lb gamma BHC	780
1 lb DDT plus $\frac{1}{4}$ lb gamma BHC	849
$\frac{1}{2}$ lb Sevin	839
1 lb Sevin	923
	S.E. 38·1

Sowing date of Unsprayed Cotton at Mokwa

Observations on unsprayed cotton at Mokwa last season showed that late sowings, in that season, outyielded early sowings. Similar observations were taken this year on three groups of five plots of cotton sown on 4th July, 24th July and 14th August. The plots were one quarter acre in area and separated from each other, and from sprayed cotton, by at least one hundred yards. The results are given in Table 7; this year there was no significant difference in the yield of seed cotton from the three groups of plots.

TABLE 7

COTTON YIELDS FROM VARIOUS SOWING DATES, MOKWA, 1961

Layout: See text.

Fertilizer: $\frac{1}{2}$ cwt single superphosphate plus $\frac{1}{2}$ cwt sulphate of ammonia per acre.

Insecticide: Nil.

Sowing dates	*Seed cotton lb per acre*	*Plant framework lb per acre*
Normal—4th July	266	1775
Late—24th July	278	1756
Very late—14th August	236	1400
S.E.	± 18·7	

Provincial Spraying Trials

Sixty demonstration plots which included sprayed and unsprayed cotton were laid down throughout all provinces of Northern Nigeria. On the whole, the yields of the unsprayed plots confirmed that there was an advantage in following the recommendations, but the yields from the sprayed plots were disappointing. These inconclusive results can be attributed partly to the poor growing season, but other causes included the difficulty of locating plots on fertile land, and the frequent impossibility of providing adequate and continuous supervision.

In some trials low yields were obtained although the cotton was very well grown, and it is possible that in many cases the technique of spraying was faulty. Appropriate action is being taken to remedy this, but there is no doubt that any advance in this important but most difficult aspect of cotton extension work will depend on the availability of trained extension staff.

Where close supervision of sprayed cotton was possible, away from Samaru, yields were good. At the School of Agriculture, sprayed cotton gave 850 lb seed cotton per acre, compared with 425 lb per acre from unsprayed cotton. At Shika, where two unit farms have been established to try out the latest Samaru recommendations on all major crops, both farmers obtained 900 lb seed cotton per acre, all Grade I, from their three acres of cotton.

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Appendix

Origin and main characteristics of cotton strains mentioned in this report

26J New Blend The newest wave of Samaru 26J bulk stock.

QA	A mixture of two strains which are derivatives of S49 and S56.
QB	A mixture containing six strains which are derivatives of S49, S52, and S56.
S49	Previously known as 26C/49160-23. Contains material of high spinning quality.
7/36	A substrain of S49.
S52	A derivative of S48, previously known as 26C/479-25-44. High yielding but poorer in spinning quality.
S56	A derivative of S48, previously known as 26C/479-25-BCP/14.
5/44	A substrain of S56.
Glandless 26J	A strain carrying the marker gene for the recessive character "glandless", but embodying most of the field characters of 26J; used for cross pollination studies.
Albar A/58/18	A bacterial blight resistant selection from Allen, made in Uganda.

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PROGRESS REPORT FROM EXPERIMENT STATIONS

The reports for the seasons up to including 1950-51 were published in seasonal volumes; the following are still in print and available at 3/- per volume post free.

1923-25 (one volume), 1926-27, 1931-32, 1934-35,
1935-36, 1942-43 and 1945-46 to 1950-51.

From 1951-52 the reports from each territory were published individually each season. A few of the 1951-52 reports are out of print, but all others are available post free at 2/6 per report or £1 for the seasonal set.

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